# Performance of the Berkeley Gas-Filled Separator

*V. Ninov, S.A.Abbott, K.E. Gregorich, C.A. McGrath ,P.A. Wilk*

The Berkeley Gas-Filled Separator (BGS) is installed at the 88”-Cyclotron. Since the completion of the installation in Cave 1, it is being used to investigate unretarded evaporation residues formed by heavy-ion fusion.

The TOSCA design of BGS is shown in Figure 1. BGS consists of three magnets. The first one is a vertically-focusing quadrupole. The center magnet is a dipole magnet modified to produce a strong horizontally-focusing gradient. BGS is typically operated with helium gas at a pressure of 1 Torr. The total bend of BGS is $70^{o}$ and the total flight path is 4 meters at the maximum rigidity of 2.5 Tm.

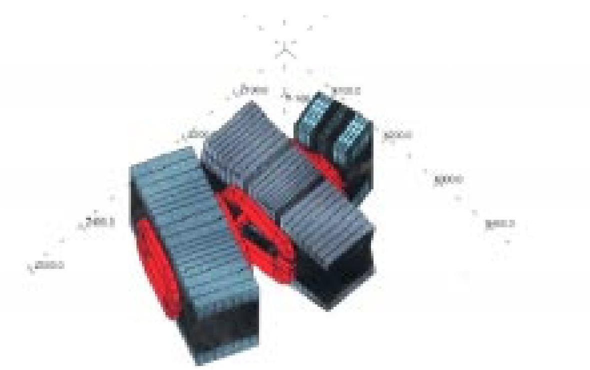

Fig. 1. The three dimensional design of BGS. The field distributions were calculated with TOSCA.

To obtain the whole variety of evaporation residues originating from one compound system, heavy ions covering wide mass-over-charge and velocity ranges must be transported to the focal plane with a good figure of merit. As the evaporation residues recoil in the beam direction, the primary accelerator beam must be suppressed effectively. BGS fulfills these requirements, as shown in Figure 2, and transports a wide range of evaporation residues with high efficiency and excellent ($> 10^{13}$) beam rejection. In combination with a detector system of high response, e.g., a position sensitive Si-detector of moderate size ($120 \times 60$ mm$^2$) in the field of $\alpha$ spectroscopy, BGS allows the spectroscopic investigation of evaporation residues with half-lives as short as one $\mu$-second and formation cross sections as low as few picobarns.

The performance of BGS was tested in a variety of projectile/target combinations ranging from very asymmetric reactions like $^{18}O+^{208}Pb$ to almost symmetric combinations like $^{78}Kr+^{102}Pd$. The operating parameters are summarized in the following table.

| | | |
|---|---|---|
| Maximum particle current: | | $5 \times 10^{12}$ / s |
| Target thickness: | | 0.1-1 mg/cm$^2$ |
| Angular acceptance: | vertical: | ± 150 mrad |
| | horizontal: | ± 75 mrad |
| Momentum Acceptance: | | > 50 % |
| Charge Acceptance: | | ~ 100 % |
| Transport efficiency: | | 40-70 % |
| Overall background rejection: | | $> 10^{13}$ |
| Focal Plane Image Size: | vertical: | 50 mm |
| | horizontal: | 80-150 mm |
| Dispersion: | | 18 mm / %Bρ |
| Separation time: | | 0.5-3 µsec |

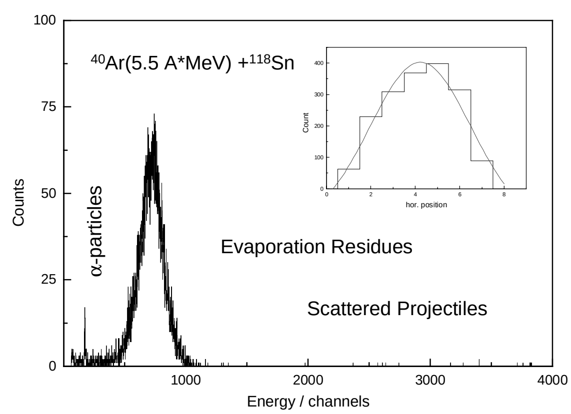


Fig. 2. Energy spectrum measured in the focal plane of BGS. The spectrum shows the implanted reaction products, the lines of their subsequent α decay and background from projectiles. The insert shows the corresponding horizontal distribution.